

## **Influence of pretreatment of biomass on pyrolysis products**

Piyali Das\* and Anuradda Ganesh

\*Energy Systems Engineering, Indian Institute of Technology Bombay, Powai,  
Mumbai – 400 076, India.

Ph: (+91)-022-576 7886; Fax: (+91)-022-572 6875; aganesh@me.iitb.ac.in

### **Introduction**

With the increasing certainty on the role of biomass in the secondary energy market over the next few decades improvement in the biomass conversion technologies have received sufficient impetus. Even though gasification promises to be a technology to be well established for power generation, the dispersed availability pattern of biomass as a major inhibitor is well known but not well absorbed. The alternate technology of having decoupling fuel generation from power generation using the pyrolysis route is slowly but surely coming up on the learning curve. Presently the problems associated with the pyrolysis oil from biomass are many for e.g. the instability, the corrosivity of the oil etc. – a very systematic research being essential.

### **Work description**

The present paper reports the studies made on the influence of pre- treatment of biomass on the pyrolysis products. A vacuum pyrolysis –packed bed set up has been used for the study. Sugarcane bagasse, being one of the biomass available in abundance in India, has been used for pyrolysis. Raveendran et. al.[1] discusses the effect of de-ashing on the total volatile fraction during pyrolysis. He has developed correlations showing the effect of zinc and potassium in presence of lignin on the change in the volatile fraction. However, the oil part has not been distinguished in the volatile fraction.

The present work is an attempt to understand the change in the oil fraction, energy content of the oil and relate it to the pre-treatment of the biomass. The change in char percentage, calorific value and its surface area were studied. The bagasse taken here was subjected to three different pre-treatment processes i.e.,

1. Water leaching
2. Mild acid treatment with HCl
3. Mild acid treatment with HF

The selection of the pretreatment processes is based on reported literature on leaching[2, 3]and coal deashing[4]process and with objective of maximum extraction of ash.

### **Results and discussion**

The ash content of untreated biomass and the subsequent ash content in the treated biomass were measured. The amount of sugar in the leachate has been determined. It was interesting to find that the amount of sugar in the leachate in all three cases is comparable (about 30%). However, the HF treated bagasse leachate contained higher percentages of xylose than glucose, wherein the other two cases had higher glucose content in the leachate. In addition, vast difference in the resulting ash contents upon pre-treatment was observed. It is interesting to note that the percentage of ash content increases with the mild HCl treatment (from 1.83% to 2.12%) as against substantial reduction in the percentage of ash through HF treatment (1.83% to 0.03%). This along with the sugar analysis in the leachate indicates selective removal of some components of biomass on different treatments. The investigations are on to identify these components. It is however important to note that mild HF treatment can de-ash the biomass to a fairly satisfactory level.

The pyrolysis of the untreated and the three treated samples in a packed bed reactor under vacuum was carried out. The product distribution in terms of char, oil and non-oil fraction, and gases has been measured. The calorific value of the char and oils has been determined to find the energy distribution in them. It is found that the percentage oil from HF treated biomass is higher than the other three (both based

on weight of treated biomass as well as based on original untreated biomass). However, the calorific value of all the oils does not show appreciable variation. They are all in the range of 23-25MJ/kg. The char adsorption properties also improve for HF treated bagasse.

### **Conclusions**

Pre-treatment of bagasse with mild HF solution is effective in reducing the ash content of the biomass to a negligible amount. Moreover, this treatment effectively increases the oil yields on vacuum pyrolysis. The calorific value however is not affected and is in the range of 25MJ/kg. The HF treatment also produces char with a higher adsorptive capacity, thereby adding value to the char obtained from pyrolysis.

### **References**

- [1] K Raveendran, Anuradda Ganesh and Kartic C Khilar, "Influence of Mineral Matter on Biomass Pyrolysis Characteristics", In: Fuel, vol. 74, n-12, 1995, pp. 1812 – 1821.
- [2] Turn, S.Q., Kinoshita, C.M., Ishimura, D.M., Jenkins, B.M, "Removal of Inorganic Constituents of Fresh Herbaceous Fuels :Process and Costs", In: Proceedings of 2<sup>nd</sup> Biomass Conference of The Americas—Energy,Environment Agriculture And Industry", August,1995,NREL, Golden Colorado.
- [3] Jenkins, B.M., Bakker, R.R. and Wei, J.B. "Removal of Inorganic Elements to Improve Biomass Combustion Properties", In: Proceeding of 2<sup>nd</sup> Biomass Conference of the Americas, NREL/CP- 200-8098.
- [4] Samaras, P. Diamadopoulos, E., Sakellaropoulos, P.G., "The Effect of Mineral Matter and Pyrolysis Conditions on Gasification of Greek Lignite by Carbon Dioxide." In: Fuel, vol. 75(9), 1996, pp 1108-1114.